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# TESTING THE FINANCE-GROWTH LINK: IS THERE A DIFFERENCE BETWEEN DEVELOPED AND DEVELOPING COUNTRIES?

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# Testing the finance-growth link: Is there a difference between developed and developing countries?

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## TESTING THE FINANCE-GROWTH LINK: IS THERE A DIFFERENCE BETWEEN DEVELOPED AND DEVELOPING COUNTRIES?


### SUMMARY

How much does financial development spur economic growth? Does financial intermediation affect positively the growth rate of the real GDP? Does the finance-growth link work whatever the level of development of countries? A vast empirical literature aims at providing an answer to these questions. Using cross-section data, the studies generally conclude in favour of a positive correlation between financial intermediation and productivity growth, as well as between financial development and capital accumulation (Leeper and Gordon (1992), Roubini and Sala-I-Martin (1992), King and Levine (1993a, 1993b)). Focusing on the issue of causality, other papers find that developed financial markets induce a strong growth and conclude in favour of bilateral causality (Jung (1986), Rajan and Zingales (1998), Beck *et al*. (2000), Calderon and Liu (2003)). The possibility that financial intermediation may be beneficial to growth is also evidenced in papers using panel data (Levine *et al*. (2000) and Beck and Levine (2003)).

The significant link between finance and economic growth is widely accepted, but the statistical evidence is based on the assumption of a *uniform* finance-growth nexus across countries. This hypothesis may be criticised, since there are several channels through which financial development affects economic growth. Such channels may differ across countries and include liquidity effects, financial depth, the role of financial intermediaries, and the reduced cost of information. Thus, in uncovering the effect of financial intermediation on the real sector, we should consider the possibility that the finance-growth nexus varies across nations. Using dynamic specifications allowing for slope heterogeneity across countries, Favara (2003) finds results that are in contradiction with the vast literature suggesting that finance and growth are positively linked. Not only does financial development have a small effect on growth, but also the impact is negative for some combination of variables and sample periods. These contradictions can be due to several reasons, such as a questionable use of econometric methodologies. What is at stake here is the robustness of the tests and estimators applied when one uses panel data.

In this paper, we revisit the evidence of the existence of a long-run link between financial intermediation and economic growth, as regards these methodological problems. We focus on the issue of cointegration between the growth rate of real GDP, control variables and three series reflecting financial intermediation. To this end, we consider a model with a factor structure that allows us to determine whether the finance-growth link is due to cross countries dependence and/or whether it characterises countries with strong heterogeneities. We employ techniques recently proposed in the panel data literature, such as PANIC analysis and cointegration in common factor models.

Our results put forward differences between developed and developing countries. More specifically, we find that, for the developing countries, cointegration occurs through cross-member dependence exclusively. For the developed countries, to find a significant relationship, we also need to consider the finance-growth links that are specific to each country. On the whole, on the 1980-2006 period, our results show that financial intermediation — mainly through financial depth which is the most important financial variable — is a positive determinant of growth in developed countries, while it acts negatively on the economic growth of developing countries.

**ABSTRACT**

We revisit the evidence of the existence of a long-run link between financial intermediation and economic growth, by testing of cointegration between the growth rate of real GDP, control variables and three series reflecting financial intermediation. We consider a model with a factor structure that allows us to determine whether the finance-growth link is due to cross countries dependence and/or whether it characterises countries with strong heterogeneities. We employ techniques recently proposed in the panel data literature, such as PANIC analysis and cointegration in common factor models. Our results show differences between the developed and developing countries. We run a comparative regression analysis on the 1980-2006 period and find that financial intermediation is a positive determinant of growth in developed countries, while it acts negatively on the economic growth of developing countries.

**JEL Classification**: C5; G2; O5.

**Keywords**: financial intermediation; growth; common factor; panel data; PANIC analysis.

## LA RELATION FINANCE – CROISSANCE ECONOMIQUE : EXISTE-T-IL UNE DIFFERENCE ENTRE LES PAYS DEVELOPPES ET LES PAYS EMERGENTS ?


**RESUME LONG**

De quelle manière le développement financier stimule-t-il la croissance économique ? L'intermédiation financière affecte-t-elle positivement le taux de croissance du PIB réel ? Le lien entre finance et croissance économique s'exerce-t-il quel que soit le niveau de développement des pays ? Une littérature importante a tenté de répondre à ces interrogations. Les études utilisant des données en coupe tendent généralement à conclure en faveur de l'existence d'une corrélation positive entre l'intermédiation financière et la croissance de la productivité, tout comme entre le développement financier et l'accumulation du capital (Leeper et Gordon (1992), Roubini et Sala-I-Martin (1992), King et Levine (1993a, 1993b)). D'autres travaux, centrés sur l'analyse de causalité, montrent que les marchés financiers développés induisent une forte croissance économique et concluent en faveur de l'existence d'une causalité bilatérale (Jung (1986), Rajan et Zingales (1998), Beck *et al*. (2000), Calderon et Liu (2003)). Le fait que l'intermédiation financière puisse être bénéfique pour la croissance est également mis en évidence dans les études utilisant les données de panel (Levine *et al*. (2000), Beck et Levine (2003)).

La relation significative existant entre finance et croissance économique est globalement acceptée dans la littérature, mais l'évidence empirique est basée sur l'hypothèse d'un lien *uniforme* entre finance et croissance entre les différents pays. Cette hypothèse est critiquable dans la mesure où il existe de nombreux canaux par lesquels le développement financier peut stimuler la croissance et que ceux-ci sont variables selon le niveau de développement des pays (effets de liquidité, importance de l'intermédiation financière, rôle des intermédiaires financiers et réduction des coûts d'information). En conséquence, il nous semble qu'une étude des effets de l'intermédiation financière sur le secteur réel doit tenir compte du fait que la liaison entre finance et croissance peut varier selon le pays considéré. Utilisant des spécifications dynamiques autorisant une hétérogénéité entre les pays, Favara (2003) obtient des résultats en contradiction avec la majorité de la littérature. Non seulement le développement financier aurait une faible influence sur la croissance, mais, de plus, son impact serait négatif dans certains cas. Cette contradiction peut résulter de divers éléments, notamment des techniques économétriques utilisées. Plus précisément, cette contradiction

peut être liée au manque de robustesse des tests et des estimateurs appliqués lorsque l'on travaille sur données de panel.

Dans cet article, nous proposons de revisiter l'existence d'une relation de long terme entre intermédiation financière et croissance économique, en accordant une attention particulière à ces questions de méthodologie économétrique. Nous nous focalisons sur la question de la cointégration entre le taux de croissance du PIB réel, un ensemble de variables de contrôle et trois séries représentatives de l'intermédiation financière. A cette fin, on considère un modèle à facteurs nous permettant de déterminer si le lien entre finance et croissance caractérise des pays structurellement différents ou s'il est dû à un *artefact* (dépendance entre les différents pays). Nous utilisons des techniques récentes de l'économétrie des données de panel, comme l'analyse PANIC et la cointégration dans les modèles à facteurs communs. Nos résultats font ressortir l'existence de différences entre les pays développés et les pays émergents. Plus précisément, sur la période 1980-2006, nous montrons que l'intermédiation financière est un déterminant positif de la croissance dans les pays développés, alors qu'elle agit négativement sur la croissance des pays émergents.

**RESUME COURT**

Ce papier a pour objet de revisiter la relation de long terme entre l'intermédiation financière et la croissance économique, en testant l'existence de cointégration entre le taux de croissance du PIB réel, un ensemble de variables de contrôle et trois séries représentatives de l'intermédiation financière. On considère un modèle à facteurs nous permettant de déterminer si le lien entre finance et croissance est dû à une dépendance entre les différents pays et/ou s'il caractérise des pays présentant de fortes hétérogénéités. Nous utilisons des techniques récentes de l'économétrie des données de panel, comme l'analyse PANIC et la cointégration dans les modèles à facteurs communs. Nos résultats font ressortir l'existence de différences entre les pays développés et les pays émergents. Plus précisément, sur la période 1980-2006, nous montrons que l'intermédiation financière est un déterminant positif de la croissance dans les pays développés, alors qu'elle agit négativement sur la croissance des pays émergents.

**Classification JEL**: C5; G2; O5.

**Mots clés** : intermédiation financière; croissance; facteurs communs; données de panel; analyse PANIC.

## 1. Introduction

How much does financial development spur economic growth? Does financial intermediation affect positively the growth rate of the real GDP? Does the finance-growth link work whatever the level of development of countries? A vast empirical literature aims at providing an answer to these questions. Leeper and Gordon (1992), Roubini and Sala-I-Martin (1992), King and Levine (1993a, 1993b) constitute early attempts to tackle empirically these issues. Using cross-section data, the authors conclude in favour of a positive correlation between financial intermediation and productivity growth, as well as between financial development and capital accumulation. Focusing on the issue of causality, other papers find that developed financial markets induce a strong growth and conclude in favour of bilateral causality (see, among others, Jung (1986), Rajan and Zingales (1998), Beck *et al*. (2000), Calderon and Liu (2003)). The possibility that financial intermediation may be beneficial to growth is also evidenced in papers using panel data. Two influential papers are Levine *et al*. (2000)'s and Beck and Levine (2003)'s who report general method of moments (GMM) and dynamic panel estimates.

The significant link between finance and growth or the level of economic development is widely accepted, but the statistical evidence is based on the assumption of a *uniform* finance-growth nexus across countries. This hypothesis may be criticised, since there are several channels through which financial development affects economic growth. These channels have been extensively examined in the theoretical literature and include liquidity effects, financial depth, the role of financial intermediaries, and the reduced cost of information.[1] Thus, in uncovering the effect of financial intermediation or development on the real sector, we should consider the possibility that the finance-growth nexus varies across nations. If we control for slope heterogeneity in a regression that links financial variables to growth, do we find results that confirm the well-established significant and positive finance-growth nexus? Favara (2003) uses dynamic specifications allowing for slope heterogeneity across countries and find results that are in contradiction with the vast literature suggesting that finance and growth are positively linked.[2] Not only does financial development have a small effect on growth, but also the impact is negative for some combination of variables and sample periods. The variables and model used by the author are very similar to Levine *et al*. (2000)'s, but his sample is slightly larger and includes more developing countries over a longer time period.

[1]For a survey of the theoretical arguments, the reader may refer to Levine (2005).

[2] He applies the Pooled Mean Group Estimator (PMGE) proposed by Pesaran, Shin and Smith (1999).

There are several views that can be taken with respect to these contradictory results. One position is to look at the historical experiences around the developing countries over the last 25 years. The observations do not confirm a systematic link between finance and growth. There are economies with high growth rates but weak financial and intermediation systems (with limited access to long-run financing, limited capacity of domestic banks and paucity of financial experience). Ethiopia is a typical example. Other countries have had sluggish growth but buoyant stock exchange and credit markets. A typical example is South Africa. In other cases, the developments of financial markets and banking activities have been accompanied by a resurgence of sustained economic growth. Some Asian and Latin American countries may be classified in this third category. Finally, some countries combine low growth rates and under-developed banking sector. This concerns many low-income countries. All in all, it may prove difficult to conclude in favour or against a significant finance-growth nexus given the diversity of the situations, since empirical studies usually measure *average* effects.

A second position is to claim that some variables measuring financial development or intermediation have an ambiguous status. The literature has pointed out that variables, such as the banking depth, or credit to the private sector, measure the size of the financial sector while also being good predictors of banking crises. In this respect, we are not surprised to find a non-significant or even negative influence of these variables on growth.

A third position leads to say that, in light of the overwhelming empirical evidence of a significant link between financial intermediation or development and growth, the results obtained by Favara (2003) and other papers that may find a non significant link rely on a questionable use of econometric methodologies. What is at stake here is the robustness of the tests and estimators applied when one uses panel data.

In this paper, we revisit the evidence of the existence of a long-run link between financial intermediation and economic growth, as regards the third viewpoint. We focus on the issue of cointegration between the growth rate of real GDP, control variables and three series reflecting financial intermediation. Using panel data and allowing for the possibility that a variety of relationships characterise the finance-growth nexus across countries, we consider the basic empirical model:

$$\Delta y_{it} = \phi_1 y_{it-1} + \phi_2 X_{it} + \phi_3 Z_{it} + \varepsilon_{it}, \tag{1}$$

where $y_{it}$ is the logarithm of the real GDP in country *i*, $X_{it}$ and $Z_{it}$ are two vectors of financial intermediation and control variables. $\varepsilon_{it}$ is an error term. $\phi_1$ , $\phi_2$ and $\phi_3$ are vectors of coefficients. We want to see whether growth and its determinants move together over long periods and, in this respect, test for the existence of a cointegration relationship. One may wonder why growth is our endogenous variable, instead of the level of per-capita GDP, since we would expect it to be *I(0)*. A central question is: what is meant by growth? A convergence model allows for two types of growth dynamics: on one hand, the convergence to a balance growth path (which is expected to be mean-reverting) and, on the other hand, a transitional growth dynamics (fluctuations in the neighbourhood of this balanced growth path, which are expected to be persistent). It is known that the application of standard unit root tests implies size distortions in the presence of transitional growth. These tests are biased towards rejection of the null of a unit root and thus may induce inappropriate model specification. The application of appropriate tests shows that transitional growth is usually characterised by a persistent dynamics (see Bernd and Lütkepohl (2004)). We do not know *a priori* which types of dynamics do characterise our series. So, our growth variables can be either *I(0)* or *I(1)*.

A rejection of the null of no cointegration in Equation (1) is taken as empirical evidence in favour of a significant long-run relationship between financial intermediation and growth when one controls for the influence of other macroeconomic variables. Doing this, there is a caveat that is worth discussing. When one concludes in favour of cointegration, the standard tests do not allow saying whether this reflects a long-run relationship between the endogenous and explanatory variables in each country, or whether the acceptance of cointegration is caused by cross-sectional dependence.[3] Cross-member cointegration, if not taken into account, induces spurious regression and test analyses (see Barnejee *et al*. (2004, 2005a, 2005b), Urbain and Westerlund (2006)). Cointegration among the members of the panel may arise for several reasons: the countries belong to the same geographical area, the governments implement common economic policies, they face the same macroeconomic constraints, *etc*. This paper examines the finance-growth link in heterogeneous panels, under the assumption of cross-sectional dependence. We find that, for the developing countries, cointegration occurs through cross-member dependence exclusively. For the developed countries, to find a significant relationship, we also need to consider the finance-growth links that are specific to each country. This finding is interesting, since it allows us to say something about the robustness of studies based on panel data methodologies. As far as the developing countries are concerned, pooled-based estimators such as those considered in Levine *et al*. (2000)'s

[3] We call 'standard' cointegration tests those proposed by Pedroni (1999, 2004), Pesaran, Shin and Smith (1999), which are widely applied to heterogeneous panel data.

paper can be considered as being reliable. Assuming homogeneous behaviours across the panel is not restrictive. Meanwhile, pooled-based estimators may yield spurious estimations when applied to sample of developed countries. In this case, it would be better to use estimators allowing for heterogeneous slopes in the regressions.

To tackle this issue, our methodology builds on models with an unobserved common factor structure proposed in the econometric literature to test for unit root and cointegration in panel data (see Bai and Kao (2004), Bai and Ng (2004), Banerjee and Carrion-I-Silvestre (2005), Gengenbach *et al*. (2006), Edgerton and Westerlund (2006), Hanck (2006)). The basic idea is that non-stationarity in a variable, or a combination of variables, originates from two sources: the presence of cross-sectional common stochastic trends and non-stationary idiosyncratic components. The proposed methodology allows extracting the common factors and idiosyncratic components in the raw data and applying residual-based tests on the defactored data.

The remainder of the paper is organized as follows. Section 2 briefly sketches out the principles of the econometric approach to test for no-cointegration when a panel is characterized by cross-member dependence. In Section 3, we present the data, while Section 4 contains our comments of the results. Section 5 presents comparative estimations of the long-run finance-growth relationship. Section 6 concludes.

## 2. The econometric methodology

The framework considered in this paper builds on Bai and Ng (2004) and Gengenbach *et al*. (2006). We focus on the general philosophy of the methods, referring the reader to the authors' papers for a technical exposition.

We consider a regression with a dependent variable $Y_{it}$ and an explanatory variable $X_{it}$:

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}\,. \tag{2}$$

The indices $i$ and $t$ refer to cross-section and time-series observations, with $i=1,\ldots,N$ and $t=1,..,T$. Though we assume a bivariate system (with only one explanatory variable) for ease of exposition, the arguments can be extended to a multivariate regression. $\varepsilon_{it}$ is an error term that is *iid*. Both the dependent and explanatory variables have a factor structure:

$$Y_{it} = D_{it}^{Y} + \lambda_i^{Y'} F_t^{Y} + e_{it}^{Y}, \qquad X_{it} = D_{it}^{X} + \lambda_i^{X'} F_t^{X} + e_{it}^{X} \tag{3}$$

$D_{it}^{Y}$ and $D_{it}^{X}$ are deterministic unobserved components (individual specific effects and/or individual specific polynomial trend functions). $F_t^{Y}$ and $F_t^{X}$ are two vectors of common factors and $\lambda_i^Y$, $\lambda_i^X$ are vectors of factor loadings. The common factors describe the behaviour of a 'representative' member of the panel, while the factor loadings capture the distance of an individual from the representative member. $e_{it}^Y$ and $e_{it}^X$ are idiosyncratic components reflecting the specific behaviour of an individual that is independent of the remainder of the panel.

Both the common factor and idiosyncratic components are assumed to follow autoregressive processes:

$$F_t^Y = \Gamma^Y F_{t-1}^Y + V_t^Y, \quad F_t^X = \Gamma^X F_{t-1}^X + V_t^X, \quad t = 1, \cdots, T, \tag{4}$$

$$e_{it}^Y = \gamma^Y e_{it-1}^Y + w_{it}^Y, \; e_{it}^X = \gamma^X e_{it-1}^X + w_{it}^X, \;\; i = 1, \ldots, N \; and \; t = 1, \ldots, T, \tag{5}$$

where $\Gamma^Y$, $\Gamma^X$ are matrices of coefficients and $\gamma^Y$, $\gamma^X$ are coefficients. $V_t^Y$, $V_t^X$, $w_{it}^Y$, $w_{it}^X$ are respectively matrices and vectors of stationary components. Suppose that some of the autoregressive coefficients equal 1. In this case, some of the common factors and/or idiosyncratic components have a unit root. The common factors, the idiosyncratic components or both may drive the non-stationarity in the data. This implies several cases of cointegration: 1/ cointegration between the common stochastic trends of *Y* and *X* alone (that is cross-member cointegration), 2/ cointegration between the *I(1)* idiosyncratic components, 3/ both types of cointegration.

Standard panel unit root and cointegration tests, when applied to series with a factor structure, suffer from severe distortions and theoretical problems (see Banerjee *et al*. (2004), Urbain (2004), Gengenbach *et al*. (2005), Urbain and Westerlund (2006)). A major caveat is that the distributions of the test statistics are 'contaminated' by the presence of unit root in the factors. Recent papers on panel unit root and cointegration tests suggest working with de-factored series, which are original series from which the common factors have been removed. The procedure we employ here involves two steps.

*Step 1*. We first apply a PANIC analysis (panel data analysis to the idiosyncratic and common components) as proposed by Bai and Ng (2004). The approach consists in testing for the presence of a unit root in the common factors and idiosyncratic components separately instead of considering the observations $X_{it}$ and $Y_{it}$ directly. Indeed, if one component is *I(1)* and the other *I(0)*, it could be very difficult to establish that a unit root exists from the original observations, especially if the stationary component is large. In this case, unit root tests on the series $X_{it}$ and $Y_{it}$ can be expected to be oversized while stationarity tests will have no power.

*Step 2.*

*2a.* If we detect stochastic trends among the common factors and if all the idiosyncratic components are *I(0)*, then cointegration between $X_{it}$ and $Y_{it}$ occurs only if the *I(1)* common factors of $X_{it}$ cointegrate with the *I(1)* common factors of $Y_{it}$. In this case, we have cross-member cointegration. The null of no-cointegration is tested using a Johansen type test.

*2b*. Suppose that both *I(1)* common factors and *I(1)* idiosyncratic components are detected. Then cointegration tests are applied separately on the common and idiosyncratic components. We conclude that $X_{it}$ and $Y_{it}$ are cointegrated if the null of no-cointegration is rejected for both the factors and the idiosyncratic components. Tests on the de-factored series (*i.e*. on the idiosyncratic components) are performed using Pedroni (1999, 2004)'s procedures.

## 3. The data

This section presents the data used to test for the existence of a long-run relationship between financial intermediation and economic growth. We consider 89 countries annually observed from 1980 to 2006: 26 OECD, 21 Latin America and Caribbean (LAC), 17 Middle East and Asia (MEA) and 27 Africa. The countries are listed in Appendix 1. The sources and definitions of the data are given in Appendix 2.

*Financial intermediation variables*

We use four measures of financial intermediation. We first consider real credit by financial intermediaries to private sector as a ratio of real GDP (CREDIT). This variable is used in Levine *et al*. (2000). We further consider the real domestic credit by the banking sector in percentage of the real GDP (CREDBANK). The main difference with the former indicator comes from the fact that it does not isolate credit issued to the private sector. We also consider a measure of banking intermediation (BANKING) as the ratio of deposit money bank domestic assets to the sum of domestic assets from deposit money banks and central bank. The use of such an indicator was first suggested by King and Levine (1993a, 1993b) and captures the ability of commercial banks to find profitable loans more easily than central banks. As in King and Levine (1993a), we finally consider a variable of financial depth (FIDEPTH), which is the ratio of liquid asset of the financial system to real GDP.[4]

[4] The empirical literature usually distinguishes bank-based and market-based financial system to examine how the relative development of stock markets and banking systems affects growth. Banking intermediation is related more to the availability of long-term financing, while the financing through securities markets tips to prevail in

*Control variables*

The set of control variables includes a proxy for initial conditions, that is the lag real GDP per-capita (GDP(-1)), trade openness (OPEN) measured as the sum of exports and imports over GDP, a proxy of relative productivity (PROD) that is the ratio of GDP per worker for a country to the GDP per worker in the group of G7 and finally the ratio of gross domestic investment to GDP (GDI). The choice of these variables is common in the literature that explores the finance-growth nexus. Relative productivity summarizes the contribution of the quality of the factors of production to the long-run growth, while the rate of investment variable is motivated by the fact that a deeper financial intermediation leads to higher factor accumulation.

## 4. Testing for cointegration between financial intermediation and growth

*The OECD countries*

We begin with the results concerning the OECD countries. This sample is used as a benchmark for the developing countries samples. The results of the PANIC procedure are shown in Table 1a. Column 2 shows that the number of common factors *r* varies from 2 to 5. These factors are computed using the procedure proposed by Bai and Ng (2002). $P_{\hat{e}}^{c}$ and $P_{\hat{e}}^{\tau}$ are the pooled tests on the idiosyncratic components, respectively in the intercept only model and in the linear trend model. $r_1^c$ and $P_{\hat{e}}^{\tau}$ are the number of common stochastic trends — that is common factors that are *I(1)* — corresponding to the intercept and linear trend models. We denote $MQ_c^c(r_1^c)$, $MQ_f^c(r_1^c)$, $MQ_c^\tau(r_1^\tau)$ and $MQ_c^\tau(r_1^\tau)$ the unit root statistics on the common components, in the intercept and linear trend models respectively. The latter are compared to theoretical values that are tabulated by Bai and Ng (2004).

As shown by the results, all our variables have common stochastic trends, meaning that a unit root exists in the common components. The conclusion is more mitigated for the idiosyncratic components, depending upon the test used. Some of these components have a unit root, especially those related to the financial variables. To test for cointegration among the stochastic trends, we consider different combinations of the explanatory variables. The estimates reported in the tables concern the models that yield the best results.

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the short-run because investors are interested by rapid short-term profits. Since the paper deals with long-run relationships, we use variables relating to the development of the banking sector, but we do not consider the influence of variables such as foreign direct investment or stock market capitalization.

Table 1b reports the results of the Johansen trace tests on the common stochastic trends. When we simply control for the initial level of real GDP, we find one cointegration relationship between growth and the financial variables. Not surprisingly, when the number of control variables is increased, more long-run relationships are found. Indeed, the effects of financial intermediation on economic growth work through multiple channels, notably, an increase in factor productivity, an increase in the efficiency of capital accumulation (that is transmitted to growth through investment rising). Also, the development of the financial sector is important for trade openness to result in a higher growth rate.

Table 1c contains the results of the panel cointegration tests on the idiosyncratic components, when this makes sense. Indeed, we test for cointegration between the variables that are *I(1).* As is seen from Table 1a, the idiosyncratic components of many explanatory variables are *I(0)*, so that we can only test the existence of a cointegration relationship between growth and the following financial variables: (*i*) BANKING, FIDEPTH (Model 1) and (*ii*) CREDIT, FIDEPTH (Model 2). We compute the seven statistics of the Pedroni (1999)'s test and find that the null of no-cointegration is often rejected.

On the whole, for the OECD countries, our results show the existence of cointegrating relationships between financial integration and economic growth. This conclusion is valid for the common components, but also when considering the idiosyncratic components.

Insert Tables (1a)-(1c) about here

*What is different with the developing countries?*

Tables (2a)-(2b), (3a)-(3b) and (4a)-(4b) present similar results respectively for the Middle East and Asian, African and Latin American and Caribbean countries. The main difference with the OECD countries is that we cannot find a long-run relationship between the financial intermediation and growth when considering the idiosyncratic components. This occurs because, either the idiosyncratic component of the endogenous variable is *I(0)* (the case of MEA and African countries), or the idiosyncratic components of the financial variables are themselves *I(0)* (the case of LAC countries). One can consider that common factors refer to the intra-individual dynamics, since they reflect the behaviour of something common to the countries over time. Idiosyncratic components capture the inter-individual differences. According to the above results, the developing countries are not heterogeneous enough – in terms of the financial intermediation channels that are conducive to growth – so that the time series properties of the finance-growth link may be very different from those of disaggregated data if the countries were considered individually. Considering the countries' specificities does not provide any information on the existence of a long-run relationship. Conversely, in the developed countries, there are several elements that distinguish the countries from each other. Some of these elements are of a microeconomic nature. For instance, the success of the link between financial intermediation and growth depends upon the capacities of individual firms to mobilize the available funds and transform them into profitable and innovative projects that promote growth (see, for instance, Rajan and Zingales (1998)). Other differences among the countries come from differences in technology, profit rates, investment and demand opportunities. These create differences in the amount of financial need needed by the firms (see Demirgüç-Kunt and Maksimovic (1998)). In the developing countries, such differences are not acute since, for some of them, they rely on loans by foreign donors (the domestic banking markets are characterised by severe market frictions).

Insert Tables (2a)-(2b), (3a)-(3b) and (4a)-(4b) about here

**5. Comparing the estimates of the developed and developing countries**

We now estimate the long-run relationships. We split the countries into two groups on the basis of our findings. We cannot apply the same estimators to the groups of developed and developing countries. Indeed, for the OECD countries we find cointegration relationships between both the common factors and idiosyncratic components, while cointegration is only found in the common factors for the group of MEA, LAC and African countries. In light of our discussion in the last paragraph, for the OECD countries, we thus need an estimator involving aspects of both homogeneous behaviours (due to common factors) and heterogeneous behaviours (due to idiosyncratic components). In this respect, for OECD countries, we apply the pooled mean group (PMG) method proposed by Pesaran *et al.* (1999). It restricts the long-run coefficients to be equal across countries, but allows for short-run coefficients and variances to differ across groups. This amounts to assuming that, though the level of financial intermediation has similar effects in the long run, there are heterogeneous adjustments across countries to changes in the level of financial intermediation. For the MEA, African and LAC countries, as a consequence of our previous discussion, pooling the data yields enough information about the link between growth and financial intermediation. We thus apply the generalized method of moments (GMM) usually employed in dynamic panel models.

Let us first comment the results relating to OECD countries. Estimates of the long-run coefficients based on the PMG estimator are displayed in Table 5. Note that, although we consider short-run coefficients in the regressions, our main interest is on the long-run relationships. The short-run coefficients are considered here since they influence the estimates of the long-run coefficients. We control for the cross-sectional dependence by demeaning the data, taking each variable in deviation from its cross sectional mean. The estimates suggest that in three models out of four, the relationship between financial intermediation and growth is positive, though the elasticities seem small in magnitude. Private credit is significant only at the 10% level of confidence in model 2, but insignificant in model 4. The impact of financial depth is increased when other macroeconomic variables are appropriately controlled for. We, however, find a negative impact of banking intermediation in model 1. Favara (2003) also finds that, when using panel estimators with heterogeneous slope coefficients, the relationship between finance and growth can sometimes be puzzlingly negative. One explanation of the negative sign of the variable BANKING may be that, the size of the banking system inadequately captures the beneficial effect of financial intermediary development on growth. The financial depth seems more appropriate to measure the channels through which finance positively affects growth in the developed countries, namely the amelioration of information frictions and the reduction of transaction costs. Another explanation of the negative sign may be that the OECD sample is composed of a majority of countries with a market-based financial development. So, BANKING is not the appropriate variable.

Comparing the usual estimates found in the literature to ours, we observe that the latter are much smaller in magnitude. For instance, using a GMM estimator, Levine *et al*. (2000) obtain an elasticity of 1.52 for private credit, 2.95 for liquid liabilities and 2.43 for banking intermediation. We checked that our findings are not due to misspecifications. The models pass the h-test. Indeed a p-value greater than 0.05 indicates no significant differences between the PMG and mean group estimator, thereby suggesting that our assumption of long-run homogenous coefficient is valid. Also, the lags in our models were appropriately selected in an ADRL model using Akaike criterion. The higher magnitude of the elasticities of the financial variables obtained in the literature may come from the fact that, assuming homogeneous impact of finance on growth across countries in a dynamic model where units are heterogeneous, yields upward biased estimated. This is not to say that those results are false, but the estimates are not robust to the estimators used and the presence of idiosyncratic components can lead to misleading conclusions.

The non-financial variables, when significant, have the expected signs. We find a positive impact of the degree of openness on growth, a positive impact of productivity and of the investment rate. The lagged real GDP shows a convergence phenomenon between the OECD countries.

Insert Table 5 about here

We now turn to the non-OECD countries. Tables 6 and 7 contain the results for the developing countries. We apply a GMM system estimation by combining the regressions in differences with the regressions in levels, as suggested in Arellano and Bover (1995) and Blundell and Bond (1998). The instruments for the regressions in levels are the lagged differences of the endogenous and explanatory variables, while the instruments in the regressions in differences are the lagged values of the variables in levels. The validity of the instruments is tested using the Sargan test for over-identifying restrictions. We use a heteroskedasticity and autocorrelation consistent covariance matrix. As is seen in the Tables all the regressions pass the Sargan test, meaning that our instruments are valid. A striking difference of these regressions compared to those of the developed countries is the negative impact of the financial intermediation variables on growth in many regressions, whether or not the elasticities are statistically significant. The negative influence of the financial variables on the real economy in the developing countries is frequent in the empirical literature. This finding has received different interpretations. For instance, De Gregorio and Guidotti (1995) find a long-run negative correlation between financial development and growth in a panel data for Latin America and interpret their result as the effects of liberalisation experience of the financial markets in these countries. Indeed, as noticed by the authors, during the 1970s and 1980s, Latin American financial markets were exposed to extreme conditions. In this context, according to De Gregorio and Guidotti (1995), their results "*may reflect the effects of experiments of extreme liberalisation of financial markets followed by their subsequent collapse*". Berthelemy and Varoudakis (1998) find a similar negative correlation on a panel of 82 countries over the period from 1960 to 1990. They proposed an interpretation in terms of threshold effects in the finance-growth relationship, the threshold being associated with the existence of multiple equilibria. More specifically, two stable equilibria exist: a low equilibrium such that slow growth is coupled with a weak-banking sector, and a high equilibrium such that strong growth is associated with developed financial intermediation. Between these two equilibria, an unstable equilibrium exists which determines the threshold effect of financial intermediation on economic growth. Finally, our results highlight differences among the developing countries. The financial variables are very often significant for the LAC and MEA countries (in three regressions out of four), but quite never significant for the African countries (only one regression). The financial depth seems to be the most determinant financial variable that explains the link between financial intermediation and growth.

Insert Tables 6 and 7 about here

**6. Conclusion**

In this paper, we have re-examined the question of the impact of financial intermediation on economic growth by considering the implications of cross sectional dependence in panel data. We found that this impact is explained by cross-country cointegration in the developing countries, while specific country effects also matter for the developed ones. This finding has some implications in terms of estimation. For the former, pooled-based panel data methods are indicated, while for the latter estimators allowing for possible heterogeneities among the countries are more appropriate. A comparative analysis of the regressions shows a major difference between both categories of countries. While financial intermediation variables positively influence growth in the OECD countries, they enter negatively in the finance-growth relationship for the developing countries. This calls for caution when considering panel data studies where all the countries are included in a same sample.

The present analysis can be extended in several ways. It would be interesting to consider the implications of the common-idiosyncratic decomposition in terms of regression analysis and not only in terms of cointegration testing procedures as we did here. Also, examining the issue of causality in the framework of common factor models would seem a promising approach.

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**Appendix 1. List of countries**

| *OECD* | *Latin America and Caribbean* | *Middle East and Asia* | *Africa* |
|---|---|---|---|
| Australia | Argentina | Bangladesh | Burundi |
| Austria | Bolivia | India | Cameroon |
| Belgium | Brazil | Indonesia | Central Africa |
| Canada | Chile | Iran Islamic Republic | Chad |
| Denmark | Colombia | Israel | Congo Republic |
| Finland | Costa Rica | Jordan | Benin |
| France | Dominican Republic | Korea | Ethiopia |
| Germany | Ecuador | Malaysia | Gabon |
| Greece | El Salvador | Nepal | Ghana |
| Iceland | Guatemala | Pakistan | Côte d'Ivoire |
| Ireland | Haiti | Papua New Guinea | Kenya |
| Italy | Honduras | Philippine | Lesotho |
| Japan | Jamaica | Singapore | Madagascar |
| Korea | Mexico | Sri Lanka | Malawi |
| Luxembourg | Nicaragua | Syria | Mali |
| Mexico | Panama | Thailand | Mauritius |
| New Zealand | Paraguay | | Morocco |
| Norway | Peru | | Niger |
| Portugal | Trinidad and Tobago | | Nigeria |
| Spain | Uruguay | | South Africa |
| Sweden | Venezuela | | Zimbabwe |
| Switzerland | | | Rwanda |
| The Netherlands | | | Senegal |
| Turkey | | | Sierra Leone |
| United Kingdom | | | Togo |
| USA | | | Uganda |
| | | | Zambia |

## Appendix 2. Definition of variables and sources

| *Variable* | *Description and sources* |
|---|---|
| *Financial variables* | |
| Financial depth | Ratio of liquid asset of the financial system to GDP. As in King and Levine (1993), we choose M3 or M2 if M3 is not available. The ratio is computed as follows $$\frac{0.5\times\left(M3_t\ /\ CPI_t^e+M3_{t-1}\ /\ CPI_{t-1}^e\right)}{GDP_t\ /\ CPI_t^a}$$ where $CPI^e$ and $CPI^a$ are end-of-period and average CPI and GDP is nominal GDP in local currency.<br>Sources :<br>- Nominal GDP: World Development Indicators (WDI) and International Financial Statistics (IFS).<br>- M2: WDI for the developing countries. For UK and the European countries, we use M3 from Eurostat statistics until 1998 (M3 from 1998 to 2006 is based upon authors' calculation).<br>- CPI end of period: WDI and IFS.<br>- Average CPI: computed from the series of end of period CPI. |
| Banking intermediation | Ratio of deposit money bank domestic assets to deposit money bank domestic assets plus central bank domestic assets.<br>Source: IFS. Numerator =line 22 and denominator = sum of lines 22 and 12. |
| Credit to private sector (as a ratio of GDP) | Domestic credit to private sector in percentage of GDP.<br>Source: WDI. |
| Domestic credit by banking sector in % of GDP | The ratio is computed as follows $$\frac{0.5\times\left(CRED_t\ /CPI_t^e+CRED_{t-1}/CPI_{t-1}^e\right)}{GDP_t\ /CPI_t^a}$$ where *CRED* is credit by banking sector, $CPI^e$ and $CPI^a$ are end-of-period and average CPI and GDP is nominal GDP in local currency.<br>Sources :<br>- CRED = line 22D (IFS).<br>- CPI end of period: WDI and IFS.<br>- Average CPI: computed from the series of end of period CPI.<br>- Nominal GDP: World Development Indicators (WDI) and International Financial Statistics (IFS). |
| *Control variables* | |
| Degree of openness | Sum of real exports and real imports as share of real per-capita GDP.<br>Sources: WDI and OECD. |

| | |
|---|---|
| Gross domestic investment (as share of GDP) | Source: IFS and WDI. |
| Relative productivity | Ratio of GDP per worker for a country to the GDP per worker in Group of Seven (G-7).<br>Source: we collect data on labour force and GDP for each country from the Global Development Finance. We compute the ratio of GDP to labour force to obtain the GDP per worker. |
| Real per-capita GDP | To obtain the per-capita GDP, we use a population series from the World Bank Development Indicators. To compute the real value, we use the GDP deflator and the CPI if the GDP deflator is not available.<br>Source: WDI. |
| *Dependent variable* | |
| Growth | First-difference of *log* of the real GDP. |

*Table 1a. Results of the PANIC procedure*

Sample 1: OECD Countries

| | Constant term case | | | | | | Linear trend case | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $r$ | $P_{\hat{e}}^{\tau}$ (ADF) | $P_{\hat{e}}^{c}$ (GLS) | $r_1^c$ | $MQ_c^c(r_1^c)$ | $MQ_f^c(r_1^c)$ | $r$ | $P_{\hat{e}}^{\tau}$ (ADF) | $P_{\hat{e}}^{c}$ (GLS) | $P_{\hat{e}}^{\tau}$ | $MQ_c^{\tau}(r_1^{\tau})$ | $MQ_f^{\tau}(r_1^{\tau})$ |
| **GROWTH** | 2 | 92.1082 | 103.734 | 2 | -29.4166** | -27.4623 | 2 | 73.3989 | 48.0876 | 2 | -29.5236** | -27.3803 |
| **GDP(-1)** | | | | | | | | | | | | |
| **PROD** | 5 | 27.8561*** | 35.3441*** | 5 | -25.1246 | -30.1884 | 5 | 40.2661*** | 35.0854*** | 5 | -25.7844 | -30.7219 |
| **INFLATION** | | | | | | | | | | | | |
| **GDI** | 5 | 21.2283*** | 29.4646*** | 5 | -11.3106 | -18.5901 | 5 | 16.9399*** | 17.3612*** | 5 | -22.0715 | -26.5748 |
| **OPEN** | 4 | 54.1434 | 58.2573 | 4 | -11.4119 | -11.6739 | 4 | 42.9606*** | 39.9876*** | 4 | -12.1601 | -15.4057 |
| **CREDBANK** | 4 | 38.7249*** | 30.3147*** | 3 | -11.2858 | -12.3643 | 4 | 43.5571*** | 32.7957*** | 3 | -14.6480 | -17.5660 |
| **CREDPRIV** | 5 | 54.4530 | 30.6248*** | 4 | -11.6657 | -18.5470 | 5 | 51.1784 | 38.2720*** | 5 | -42.8063 | -28.5570 |
| **BANKING** | 4 | 63.2747 | 34.1565*** | 4 | -17.3053 | -16.3907 | 4 | 43.8577*** | 26.0227*** | 4 | -19.9899 | -25.8042 |
| **FIDEPTH** | 5 | 78.8480 | 38.5228*** | 5 | -15.7827 | -24.2071 | 5 | 75.3094 | 28.7374*** | 5 | -24.8323 | -21.2789 |

Note: $r$ is the number of common factors obtained by applying the Bai and Ng (2002)' procedure. $P_{\hat{e}}^{c}$ and $P_{\hat{e}}^{\tau}$ are the pooled tests on the idiosyncratic components, respectively in the intercept only model and in the linear trend model. $r_1^c$ and $P_{\hat{e}}^{\tau}$ are the number of common stochastic trends corresponding to the intercept and linear trend models. We denote $MQ_c^c(r_1^c)$, $MQ_f^c(r_1^c)$, $MQ_c^{\tau}(r_1^{\tau})$ and $MQ_c^{\tau}(r_1^{\tau})$ the unit root statistics on the common components, in the intercept and linear trend models respectively. *: (resp. **, ****) indicate the rejection of the null hypothesis (unit root) at the 10% (resp. 5%, 1%) significance level.

*Table 1b. Johansen trace tests on the common stochastic trends*

Sample 1: OECD countries

| | | | | | |
|---|---|---|---|---|---|
| *Model 1: vector=(GROWTH, GDP(-1), BANKING, FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 69.39 | 63.0 | 39.62 | 31.40 | - |
| R=1 | 29.77 | 42.4 | 20.2 | 25.5 | 1 |
| R=2 | 9.57 | 25.3 | 9.01 | 19.0 | - |
| R=3 | 0.56 | 12.2 | 0.56 | 12.20 | - |
| *Model 2: vector=(GROWTH, GDP(-1), CREDIT, FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 65.99 | 63.0 | 27.17 | 31.4 | - |
| R=1 | 32.44 | 42.4 | 21.12 | 25.5 | 1 |
| R=2 | 10.76 | 25.3 | 16.15 | 19.0 | - |
| R=3 | 0.48 | 12.2 | 0.68 | 12.20 | - |
| *Model 3: vector=(GROWTH, GDP(-1), PROD, GDI, OPEN ,FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 759.48 | 114.9 | 623.83 | 44.0 | - |
| R=1 | 135.65 | 87.3 | 79.50 | 37.5 | - |
| R=2 | 56.14 | 63.0 | 28.57 | 31.4 | 2 |
| R=3 | 27.57 | 42.4 | 15.65 | 25.5 | - |
| R=4 | 11.91 | 25.3 | 11.9 | 19.0 | - |
| R=5 | 0.0039 | 12.20 | 0.004 | 12.2 | - |
| *Model 4: vector=(GROWTH, GDP(-1), PROD, GDI, OPEN, CREDIT)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 773.62 | 114.9 | 626.23 | 44.0 | - |
| R=1 | 147.38 | 87.3 | 64.99 | 37.5 | - |
| R=2 | 82.39 | 63.0 | 40.76 | 31.4 | - |
| R=3 | 41.63 | 42.4 | 28.83 | 25.5 | 3.4 |
| R=4 | 12.79 | 25.3 | 11.22 | 19.0 | - |
| R=5 | 1.57 | 12.20 | 1.57 | 12.2 | - |

Note: the number of cointegration relationships corresponds to the line where the statistics is below the critical value.

*Table 1c. Panel cointegration tests on the idiosyncratic components*

Sample 1: OECD countries

| | GROUP $\rho$ | Panel $\rho$ | GROUP *PP* | PANEL *PP* | GROUP *ADF* | PANEL *ADF* | PANEL $\upsilon$ |
|---|---|---|---|---|---|---|---|
| *Vector of variables : (GROWTH, GDP(-1), BANKING, FIDEPTH)* | | | | | | | |
| Model with constant | -1.76 | -2.31 | -9.26 | -6.85 | -9.10 | $-\infty$ | -4.34 |
| Model with linear trend | 0.64 | -0.25 | -6.52 | -5.82 | -6.47 | $-\infty$ | -6.96 |
| *Vector of variables : (GROWTH, GDP(-1), CREDIT, FIDEPTH)* | | | | | | | |
| | GROUP $\rho$ | Panel $\rho$ | GROUP *PP* | PANEL *PP* | GROUP *ADF* | PANEL *ADF* | PANEL $\upsilon$ |
| Model with constant | -0.70 | -1.66 | -10.01 | -7.06 | -8.50 | $-\infty$ | -4.34 |
| Model with linear trend | 1.39 | 0.52 | -8.64 | -6.32 | -6.93 | $-\infty$ | -7.04 |

Note: The statistics are distributed as standard normal asymptotically. The panel *v* rejects the null of no cointegration for large positive values (here for values higher than 1.64 at the 5% level) whereas the other six tests reject it with large negative values (here for values less than –1.64 at the 5% level).

*Table 2a. Results of the PANIC procedure*

Sample 2: Middle East and Asian Countries

| | Constant term case | | | | | | Linear trend case | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $r$ | $P_{\hat{e}}^{c}$ (ADF) | $P_{\hat{e}}^{c}$ (GLS) | $r_1^c$ | $MQ_c^c(r_1^c)$ | $MQ_f^c(r_1^c)$ | $r$ | $P_{\hat{e}}^{\tau}$ (ADF) | $P_{\hat{e}}^{c}$ (GLS) | $P_{\hat{e}}^{\tau}$ | $MQ_c^{\tau}(r_1^{\tau})$ | $MQ_f^{\tau}(r_1^{\tau})$ |
| **GROWTH** | 2 | 26.1682*** | 32.6263*** | 2 | -22.7488 | -21.6640 | 2 | 30.5022*** | 15.4474*** | 2 | -20.4081 | -23.5071 |
| **GDP(-1)** | | | | | | | | | | | | |
| **PROD** | 5 | 21.6060*** | 28.5222*** | 5 | -16.7164 | -21.6163 | 5 | 50.7782 | 36.1162 | 5 | -19.3162 | -19.4807 |
| **INFLATION** | | | | | | | | | | | | |
| **GDI** | 4 | 25.4094*** | 33.7483 | 4 | -14.6568 | -18.8896 | 4 | 21.7431*** | 21.1723*** | 4 | -15.4207 | -26.4187 |
| **OPEN** | 4 | 28.8751*** | 27.3567*** | 4 | -14.6568 | -18.8896 | 4 | 31.3363*** | 26.6309*** | 4 | -16.7592 | -22.2764 |
| **CREDBANK** | 5 | 50.4684 | 42.6428 | 5 | -17.4166 | -29.2152 | 5 | 48.9477 | 21.6723*** | 5 | -20.9768 | -30.4165 |
| **CREDPRIV** | 5 | 31.6639*** | 39.3542 | 5 | -12.2802 | -29.6594 | 5 | 21.9123*** | 28.6667*** | 5 | -14.6671 | -23.1799 |
| **BANKING** | 5 | 20.5363*** | 23.5901*** | 5 | -15.0078 | -30.1069 | 5 | 37.9036 | 26.8865*** | 5 | -16.7032 | -28.8762 |
| **FIDEPTH** | 5 | 24.4179*** | 24.4173*** | 5 | -24.5159 | -26.1820 | 5 | 17.9523*** | 15.4482*** | 5 | -27.6807 | -25.3984 |

Note: see footnote Table 1a.

*Table 2b. Johansen trace tests on the common stochastic trends*

Sample 2: Middle East and Asian Countries

| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
|---|---|---|---|---|---|
| *Model 1: vector=(GROWTH, GDP(-1), BANKING, FIDEPTH)* | | | | | |
| R=0 | 70.60 | 63.0 | 43.06 | 31.4 | - |
| R=1 | 27.53 | 42.4 | 20.72 | 25.5 | 1 |
| R=2 | 6.81 | 25.3 | 6.81 | 19.0 | - |
| R=3 | 0.0026 | 12.2 | 0.0026 | 12.20 | - |
| *Model 2: vector=(GROWTH, GDP(-1), CREDIT, FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 74.59 | 63.0 | 40.71 | 31.4 | - |
| R=1 | 33.88 | 42.4 | 22.51 | 25.5 | 1 |
| R=2 | 11.37 | 25.3 | 10.82 | 19.0 | - |
| R=3 | 0.5426 | 12.2 | 0.54 | 12.0 | - |
| *Model 3: vector=(GROWTH, GDP(-1), PROD, GDI, OPEN ,FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 730.4 | 114.9 | 589.46 | 44.0 | - |
| R=1 | 140.94 | 87.3 | 56.53 | 37.5 | - |
| R=2 | 84.41 | 63.0 | 44.85 | 31.4 | - |
| R=3 | 39.56 | 42.4 | 33.95 | 25.5 | 3 |
| R=4 | 5.61 | 25.3 | 5.51 | 19.0 | - |
| R=5 | 0.0962 | 12.2 | 0.09 | | - |
| *Model 4: vector=(GROWTH, GDP(-1), PROD, GDI, OPEN, CREDIT)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 763.99 | 114.9 | 636.31 | 44.0 | - |
| R=1 | 127.68 | 87.3 | 57.21 | 37.5 | - |
| R=2 | 70.46 | 63.0 | 36.10 | 31.4 | - |
| R=3 | 34.36 | 42.4 | 22.54 | 25.5 | 3 |
| R=4 | 11.82 | 25.3 | 10.74 | 19.0 | - |
| R=5 | 1.08 | 12.2 | 1.08 | 12.2 | - |

Note: see footnote Table 1b.

*Table 3a. Results of the PANIC procedure*

Sample 3: African Countries

| | *Constant term case* | | | | | | *Linear trend case* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $r$ | $P_{\hat{e}}^{c}$ (ADF) | $P_{\hat{e}}^{c}$ (GLS) | $r_1^c$ | $MQ_c^c(r_1^c)$ | $MQ_f^c(r_1^c)$ | $r$ | $P_{\hat{e}}^{\tau}$ (ADF) | $P_{\hat{e}}^{c}$ (GLS) | $P_{\hat{e}}^{\tau}$ | $MQ_c^\tau(r_1^\tau)$ | $MQ_f^\tau(r_1^\tau)$ |
| **GROWTH** | 2 | 39.1686*** | 43.2443*** | 2 | -28.6520** | -26.9608 | 2 | 32.4968*** | 18.5603*** | 2 | -28.7930** | -26.7172 |
| **GDP(-1)** | | | | | | | | | | | | |
| **PROD** | 3 | 47.8277 | 29.8105*** | 3 | -16.1726 | -18.0178 | 3 | 50.7979 | 31.8441*** | 3 | -15.6077 | -20.0946 |
| **INFLATION** | | | | | | | | | | | | |
| **GDI** | 4 | 54.1556 | 36.8980*** | 4 | -22.5594 | -28.2034 | 4 | 77.0983 | 39.5971*** | 4 | -21.2667 | -26.3341 |
| **OPEN** | 5 | 32.1327*** | 35.1092*** | 5 | -31.5118 | -33.6793 | 5 | 53.4519 | 27.4564*** | 5 | -29.6243 | -29.2977 |
| **CREDBANK** | 4 | 45.5653*** | 48.8107 | 4 | -19.4650 | -24.1626 | 4 | 58.7232 | 43.6052*** | 4 | -20.1974 | -26.4609 |
| **CREDPRIV** | 4 | 39.6246*** | 41.7346*** | 4 | -15.6775 | -18.2977 | 4 | 58.4983 | 32.8310*** | 4 | -21.0408 | -26.6082 |
| **BANKING** | 5 | 38.6219*** | 35.8560*** | 5 | -22.1600 | -27.3955 | 5 | 60.6811 | 29.0595*** | 5 | -24.3052 | -32.2486 |
| **FIDEPTH** | 4 | 39.1283*** | 37.9579*** | 4 | -14.8262 | -19.4187 | 4 | 31.4391*** | 26.9544*** | 4 | -17.8738 | -21.6866 |

Note: see footnote Table 1a.

*Table 3b. Johansen trace tests on the common stochastic trends*

Sample 3: African countries

| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
|---|---|---|---|---|---|
| *Model 1: vector=(GROWTH, GDP(-1), BANKING, FIDEPTH)* | | | | | |
| R=0 | 93.68 | 63.0 | 51.69 | 31.4 | - |
| R=1 | 41.98 | 42.4 | 30.36 | 25.50 | - |
| R=2 | 11.61 | 25.3 | 7.93 | 19.00 | 2 |
| R=3 | 3.67 | 12.2 | 3.67 | 12.20 | - |
| *Model 2: vector=(GROWTH, GDP(-1), CREDIT, FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 79.82 | 63.0 | 34.78 | 31.4 | - |
| R=1 | 44.84 | 42.4 | 26.96 | 25.5 | - |
| R=2 | 17.88 | 25.3 | 15.69 | 19.0 | 2 |
| R=3 | 2.19 | 12.2 | 2.19 | 12.2 | - |
| *Model 3: vector=(GROWTH, GDP(-1), PROD, GDI, OPEN ,FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 735.22 | 114.9 | 590.14 | 44.00 | - |
| R=1 | 145.08 | 87.3 | 81.86 | 37.50 | - |
| R=2 | 63.22 | 63.0 | 30.42 | 31.4 | 2.3 |
| R=3 | 32.79 | 42.4 | 18.06 | 25.5 | - |
| R=4 | 14.73 | 25.3 | 8.78 | 19.0 | - |
| R=5 | 5.95 | | 5.96 | 12.2 | - |
| *Model 4: vector=(GROWTH, GDP(-1), PROD, GDI, OPEN, CREDIT)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 766.67 | 114.90 | 629.01 | 44.0 | - |
| R=1 | 137.66 | 87.3 | 70.33 | 37.5 | - |
| R=2 | 67.33 | 63.0 | 36.96 | 31.4 | - |
| R=3 | 30.37 | 42.4 | 20.21 | 25.5 | 3 |
| R=4 | 10.16 | 25.3 | 5.93 | 19.00 | - |
| R=5 | 4.21 | 12.2 | 4.22 | 12.2 | - |

Note: see footnote Table 1b.

*Table 4a. Results of the PANIC procedure*

Sample 4: Latin America and Caribbean Countries

| | *Constant term case* | | | | | | *Linear trend case* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $r$ | $P_{\hat{e}}^{c}$ (ADF) | $P_{\hat{e}}^{c}$ (GLS) | $r_1^c$ | $MQ_c^c(r_1^c)$ | $MQ_f^c(r_1^c)$ | $r$ | $P_{\hat{e}}^{\tau}$ (ADF) | $P_{\hat{e}}^{c}$ (GLS) | $P_{\hat{e}}^{\tau}$ | $MQ_c^{\tau}(r_1^{\tau})$ | $MQ_f^{\tau}(r_1^{\tau})$ |
| **GROWTH** | 2 | 65.0408 | 63.9437 | 1 | -13.5507 | -13.4272 | 2 | 48.3224 | 37.2968*** | 1 | -13.4629 | -13.1753 |
| **GDP(-1)** | | | | | | | | | | | | |
| **PROD** | 4 | 68.9953 | 38.4197*** | 4 | -21.7107 | -17.9022 | 4 | 42.0323 | 22.7412*** | 4 | -23.3279 | -22.4379 |
| **INFLATION** | | | | | | | | | | | | |
| **GDI** | 4 | 46.4094 | 33.8212*** | 4 | -15.3341 | -21.2848 | 4 | 27.8057*** | 14.4343*** | 4 | -16.8097 | -22.4046 |
| **OPEN** | 4 | 27.0375*** | 30.6668*** | 4 | -21.5791 | -20.8114 | 4 | 29.1287*** | 25.1421*** | 4 | -23.2765 | -21.2074 |
| **CREDPRIV** | 4 | 36.8767*** | 38.6353*** | 4 | -18.9808 | -23.5416 | 4 | 26.7843*** | 27.6471*** | 4 | -21.8831 | -23.0876 |
| **BANKING** | 3 | 30.7293*** | 24.0773*** | 3 | -11.6513 | -15.5337 | 3 | 21.5791*** | 21.7176*** | 3 | -11.8570 | -15.1046 |
| **FIDEPTH** | 5 | 47.4547 | 38.0629*** | 5 | -31.2227 | -21.6383 | 5 | 38.2491*** | 34.7736*** | 5 | -32.5413 | -25.0245 |

Note: see footnote Table 1a.

*Table 4b. Johansen trace tests on the common stochastic trends*

Sample 4: Latin American and Caribbean countries

| | | | | | |
|---|---|---|---|---|---|
| *Model 1: vector=(GROWTH, GDP(-1), BANKING, FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 76.31 | 63.0 | 40.11 | 31.4 | - |
| R=1 | 36.20 | 42.4 | 28.19 | 25.5 | 1,2 |
| R=2 | 8.01 | 25.3 | 6.98 | 19.0 | - |
| R=3 | 1.03 | 12.2 | 1.03 | 12.2 | - |
| *Model 2: vector=(GROWTH, GDP(-1), CREDIT, FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 69.89 | 63.0 | 41.68 | 31.4 | - |
| R=1 | 28.21 | 42.4 | 17.67 | 25.5 | 1 |
| R=2 | 10.54 | 25.3 | 8.82 | 19.0 | - |
| R=3 | 1.72 | 12.20 | 1.72 | 12.2 | - |
| *Model 3: vector=(GROWTH, GDP(-1), PROD, GDI, OPEN ,FIDEPTH)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | $+\infty$ | 114.9 | $+\infty$ | 44.00 | - |
| R=1 | 122.43 | 87.3 | 74.81 | 37.5 | - |
| R=2 | 47.62 | 63.0 | 27.75 | 31.40 | 2 |
| R=3 | 19.86 | 42.4 | 15.33 | 25.5 | - |
| R=4 | 4.53 | 25.3 | 4.51 | 19.00 | - |
| R=5 | 0.02 | 12.2 | 0.0221 | | - |
| *Model 4: vector=(GROWTH, GDP(-1), PROD, GDI, OPEN, CREDIT)* | | | | | |
| | *Trace test* | *Critical value (5%)* | $\lambda_{\max}$ | *Critical value (5%)* | *Cointegration rank* |
| R=0 | 727.13 | 114.9 | 592.35 | 44.0 | - |
| R=1 | 134.78 | 87.3 | 83.08 | 37.5 | - |
| R=2 | 51.70 | 63.0 | 25.9 | 31.4 | 2 |
| R=3 | 25.79 | 42.4 | 193.4 | 25.5 | - |
| R=4 | 6.45 | 25.3 | 6.13 | 19.00 | - |
| R=5 | 0.323 | 12.2 | 0.32 | 12.20 | - |

Note: see footnote Table 1b.

*Table 5. PMG estimator – Long-run coefficients*

Sample 1: OECD countries

| | *Model 1* | | | | *Model 2* | | | | *Model 3* | | | | *Model 4* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coef | t-ratio | h-test | p-val | Coef | t-ratio | h-test | p-val | Coef | t-ratio | h-test | p-val | Coef | t-ratio | h-test | p-val |
| $GDP_{-1}$ | -0.016* | -5.27 | 2.39 | 0.12 | -0.02* | -8.56 | 0.01 | 0.92 | -0.072* | -18.36 | 3.69 | 0.05 | -0.069* | -5.56 | 1.67 | 0.20 |
| PROD | - | - | - | - | - | - | - | - | 0.072* | 28.49 | 4.36 | 0.04 | 0.024* | 2.89 | 0.87 | 0.35 |
| GDI | - | - | - | - | - | - | - | - | 0.072* | 20.73 | 0.25 | 0.61 | 0.011 | 1.34 | 0.96 | 0.33 |
| OPEN | - | - | - | - | - | - | - | - | 0.048* | 21.51 | 0.08 | 0.77 | 0.005** | 1.705 | 0.99 | 0.32 |
| BANKING | -0.057* | -3.78 | 0.19 | 0.66 | - | - | - | - | - | - | - | - | - | - | - | - |
| FIDEPTH | 0.08* | 3.27 | 0.16 | 0.69 | 0.011* | 4.99 | 0.17 | 0.68 | 0.037* | 20.01 | 0.39 | 0.53 | - | - | - | - |
| CREDIT | | - | - | - | 0.002** | 1.957 | 1.61 | 0.20 | - | - | - | - | 0.002 | 0.89 | 1.00 | 0.32 |

Note: * Statistically significant at the 5% level of significance. ** Statistically significant at the 10% level of significance. Estimation is on demeaned data. The h-test is constructed as equivalence between the pooled mean group and the mean group estimates (see Pesaran *et al*. (1999)). Probability values are provided for this test. A value less than 0.05 leads to reject homogeneity of cross-section's long-run coefficients.

*Table 6. GMM system estimator – Coefficients of the model expressed in first-differences*

Samples 2 and 3: Middle East and Asian countries, African countries

| | *Model 1* | | | | *Model 2* | | | | *Model 3* | | | | *Model 4* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MEA | | AFRICA | | MEA | | AFRICA | | MEA | | AFRICA | | MEA | | AFRICA | |
| | Coef | t-ratio | Coef | t-ratio | Coef | t-ratio | Coef | t-ratio | Coef | t-ratio | Coef | t-ratio | Coef | t-ratio | Coef | t-ratio |
| Constant | 0.006* | 1.82 | 0.004 | 0.42 | 0.009** | 1.92 | 0.0013 | 0.76 | 0.013* | 6.05 | 0.0032 | 0.06 | 0.013$* | 6.17 | 7.05E-5 | 0.016 |
| $GROWTH_{-1}$ | 0.29* | 2.91 | 0.08 | 0.60 | 0.258* | 2.51 | 0.02 | 0.20 | 0.135** | 1.68 | -0.006 | -0.08 | 0.104 | 1.33 | -0.0001 | -0.001 |
| PROD | - | - | - | - | - | - | - | - | 0.186 | 3.74 | 0.125* | 3.35 | 0.206* | 3.80 | 0.16* | 3.73 |
| GDI | - | - | - | - | - | - | - | - | 0.023 | 0.517 | 0.016 | 0.541 | 0.026 | 0.562 | 0.018 | 0.64 |
| OPEN | - | - | - | - | - | - | - | - | 0.039 | 1.16 | 0.109* | 2.91 | 0.036 | 1.16 | 0.104* | 2.68 |
| BANKING | 0.024 | 0.46 | 0.04 | 1.49 | - | - | - | - | - | - | - | - | - | - | - | - |
| FIDEPTH | -0.142* | -2.52 | -0.10* | -2.53 | -0.147* | -2.49 | -0.04 | -1.53 | -0.08* | -2.12 | -0.07** | -1.68 | - | - | - | - |
| CREDIT | - | - | - | - | -0.0001 | -0.107 | -0.04 | -1.30 | - | - | - | - | -0.009 | -0.649 | -0.03 | -1.49 |
| DUM_9798 | 0.019 | 0.66 | - | - | -0.003 | -0.08 | - | - | -0.02** | -1.87 | - | | -0.024* | -1.96 | | |
| DUM_9100 | | | -0.005 | -0.279 | - | - | - | - | - | - | 0.005 | 0.824 | | | | |
| | Sargan | p-value | Sargan | p-value | Sargan | p-value | Sargan | p-value | Sargan | p-value | Sargan | p-value | Sargan | p-value | Sargan | p-value |
| | 0.0004 | 0.99 | 0.0007 | 0.99 | 0.0003 | 0.99 | 0.016 | 0.99 | 0.0003 | 0.99 | 0.0026 | 0.99 | 0.0004 | 0.99 | 0.002 | 0.99 |

Note: * Statistically significant at the 5% level of significance. ** Statistically significant at the 10% level of significance. For the Sargan test, the null is that the instruments are not correlated with the estimated residuals.

*Table 7. GMM system estimator – Coefficients of the model expressed in first-differences*

Sample 4: Latin American and Caribbean countries

| | *Model 1* | | *Model 2* | | *Model 3* | | *Model 4* | |
|---|---|---|---|---|---|---|---|---|
| | Coef | t-ratio | Coef | t-ratio | Coef | t-ratio | coef | t-ratio |
| Constant | 0.002* | 2.42 | 0.003* | 3.09 | 0.003* | 2.72 | 0.003* | 2.95 |
| $GROWTH_{-1}$ | 0.228* | 2.20 | 0.233* | 2.85 | 0.172 | 1.62 | 0.193* | 2.59 |
| PROD | - | - | - | - | 0.09* | 4.13 | 0.101* | 4.49 |
| GDI | - | - | - | - | 0.068* | 2.87 | 0.074* | 2.97 |
| OPEN | - | - | - | - | 0.077* | 3.13 | 0.066* | 2.78 |
| BANKING | 0.07* | 3.48 | - | - | - | - | - | - |
| FIDEPTH | -0.032* | -3.13 | -0.019* | -0.537 | -0.2* | -2.40 | - | - |
| CREDIT | - | - | -0.022* | -2.50 | - | - | -0.031 | -1.06 |
| | Sargan | p-value | Sargan | p-value | Sargan | p-value | Sargan | p-value |
| | 0.0008 | 0.99 | 0.0006 | 0.99 | 0.0006 | 0.99 | 0.0006 | 0.99 |

Note: See footnote Table 6.